Atelier scientifique Cirad-Iddri
"Agriculture, Développement et Changement Climatique »
7 juillet 2010, Montpellier

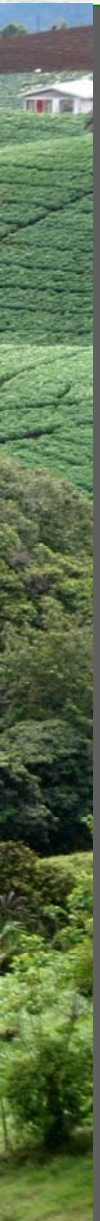
Adaptation, société et écosystèmes : Etudes d'impacts et de vulnérabilité

Bruno Locatelli, CIRAD-CIFOR

cirad
AGRICULTURAL RESEARCH FOR DEVELOPMENT

Résumé

Depuis la prise de conscience des impacts potentiels du changement climatique, les réponses se sont davantage focalisées sur l'atténuation que sur l'adaptation. Aujourd'hui, le changement du climat est perçu comme inévitable et l'adaptation prend une importance croissante dans les politiques internationales et nationales, ainsi que dans les initiatives locales. Les études scientifiques sur la vulnérabilité et l'adaptation des sociétés et des écosystèmes au changement climatique se sont multipliées ces dernières années. Différentes interprétations du concept de vulnérabilité et différentes approches sont présentées dans cette communication, avec des exemples d'études d'impacts sur les services écosystémiques et d'études de vulnérabilité de sociétés dépendantes des ressources naturelles. Ces études ont été menées dans le cadre de la collaboration entre le Cirad et le Cifor. Comme la conservation des services écosystémiques contribue à réduire la vulnérabilité sociétale, des mesures d'adaptation fondées sur les écosystèmes sont proposées. Ces mesures permettent également de créer des synergies entre adaptation et atténuation du changement climatique, au niveau des pratiques locales ou des politiques nationales.

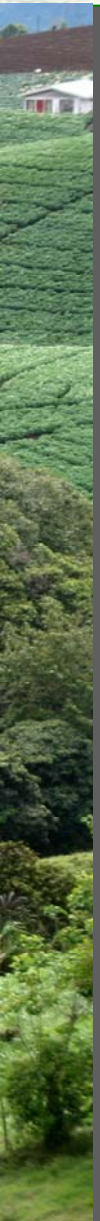


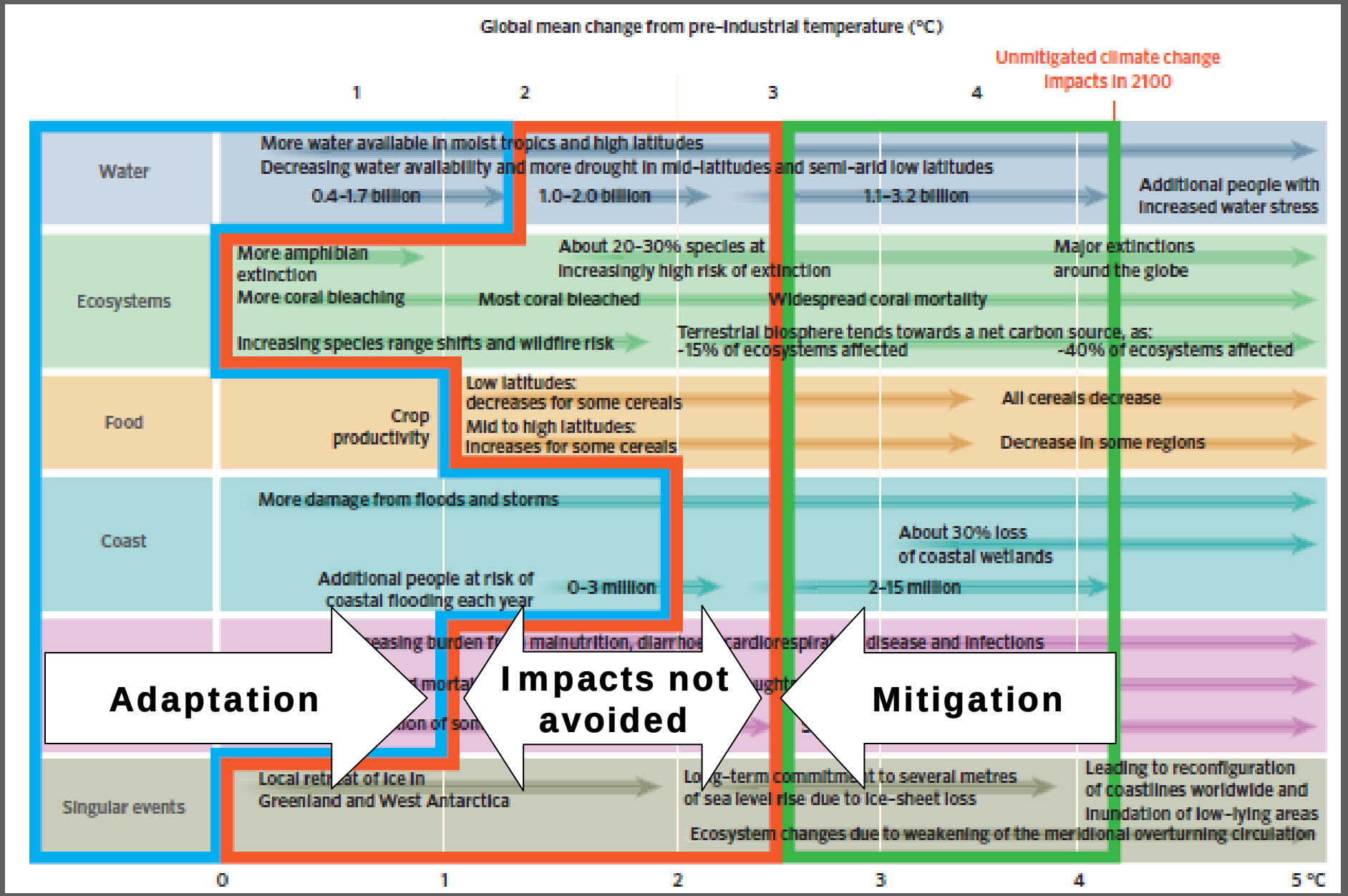
Clear message from IPCC Fourth Assessment Report (2007)

- Significant impacts are closer than we thought
- The net impact will be profoundly negative
- Even the strongest action on emissions would not avoid significant impact

We need adaptation just as much as mitigation

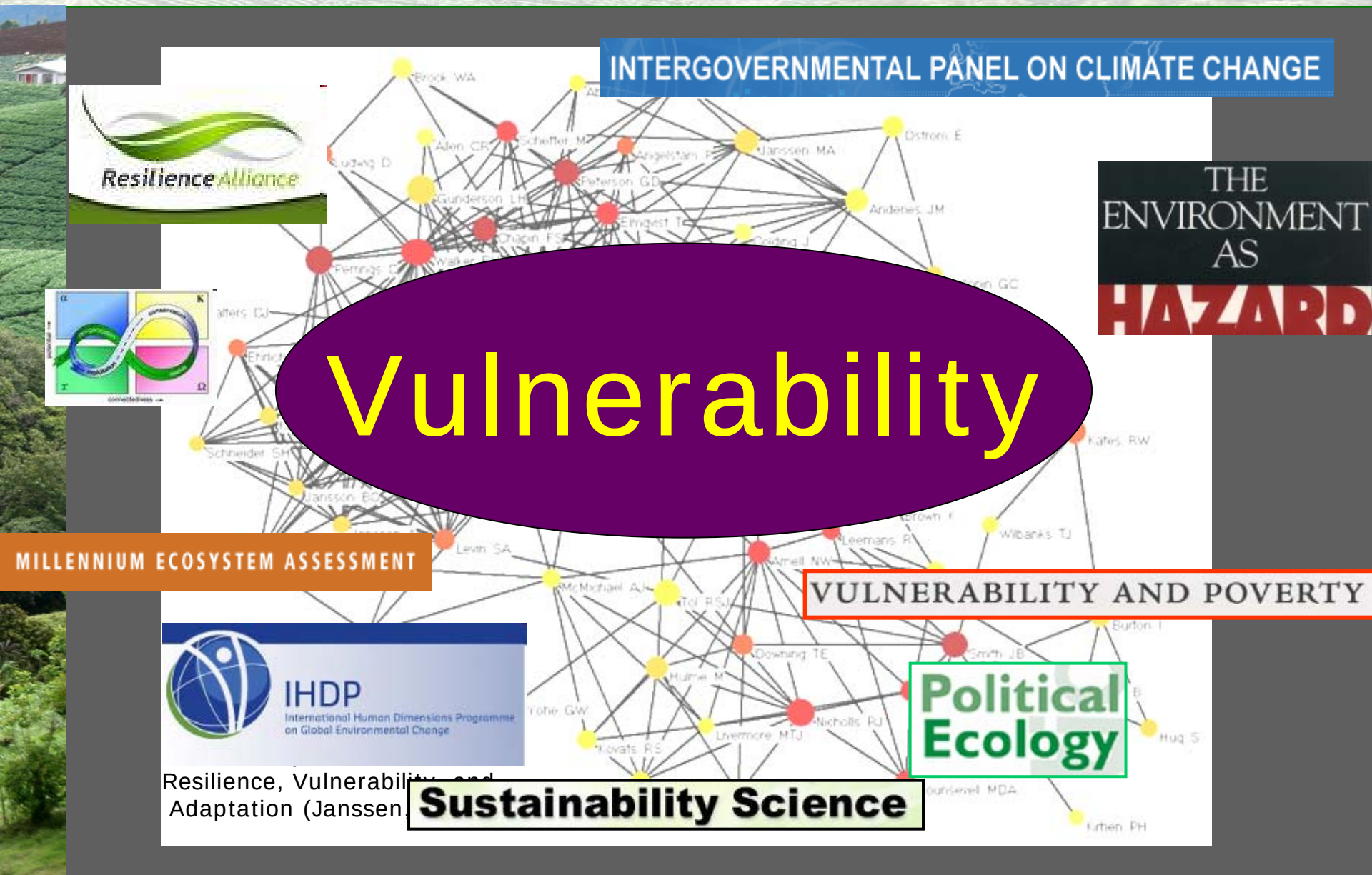
(Martin Parry, 2010)




Global mean change from pre-Industrial temperature (°C)
1
2
3
4
Unmitigated climate change impacts in 2100
Water
More water available in moist tropics and high latitudes
Decreasing water availability and more drought in mid-latitudes and semi-arid low latitudes
0.4–1.7 billion
1.0–2.0 billion
1.1–3.2 billion
Additional people with increased water stress
Ecosystems
More amphibian extinction
About 20–30% species at increasingly high risk of extinction
Major extinctions around the globe
More coral bleaching
Most coral bleached
Widespread coral mortality
Increasing species range shifts and wildfire risk
Terrestrial biosphere tends towards a net carbon source, as:
~15% of ecosystems affected
~40% of ecosystems affected
Food
Crop productivity
Low latitudes: decreases for some cereals
All cereals decrease
Mid to high latitudes: increases for some cereals
Decrease in some regions
Coast
More damage from floods and storms
About 30% loss of coastal wetlands
Additional people at risk of coastal flooding each year
0–3 million
2–15 million
Adaptation
Impacts not avoided
Mitigation
Singular events
Local retreat of ice in Greenland and West Antarctica
Long-term commitment to several metres of sea level rise due to ice-sheet loss
Leading to reconfiguration of coastlines worldwide and inundation of low-lying areas
Ecosystem changes due to weakening of the meridional overturning circulation
0
1
2
3
4
5 °C

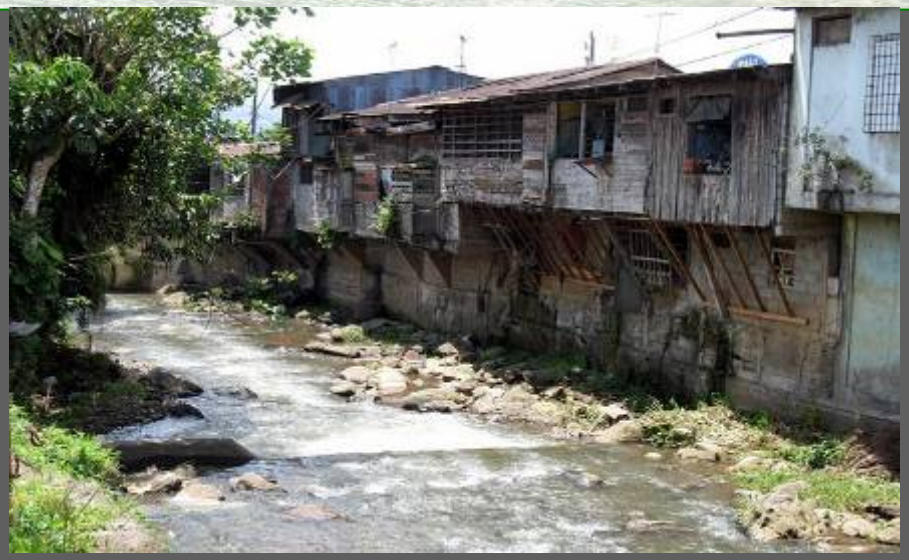
(Parry, 2010)

The adaptation landscape



Resilience, Vulnerability, and Adaptation (Janssen)

Different views on vulnerability



Risk and disaster management community

Political economists and human geographers

Hazard

External

Biophysical

Poverty

Internal

Social

The IPCC definition

(McCarthy et al., 2001)

Vulnerability

'The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes'

+ Potential Impacts (E+S)

− Adaptive Capacity

+ Exposure (E)

+ Sensitivity (S)

Risk and disaster management community

Political economists and human geographers









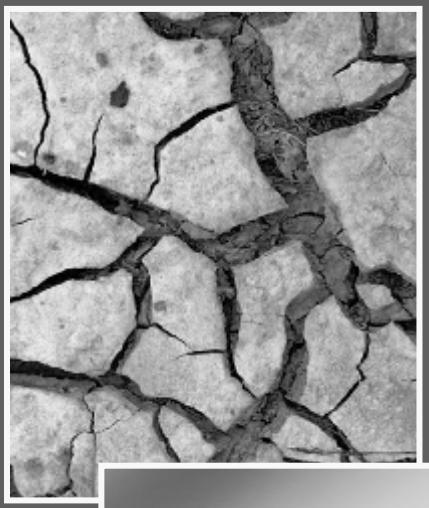
Applicability of the concept of vulnerability

Social

Systems

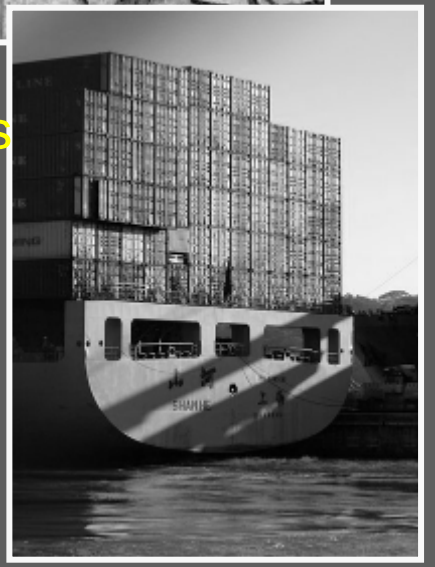
Exposure

Climate



Socio ecological

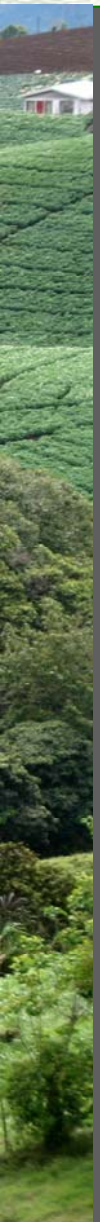
Markets

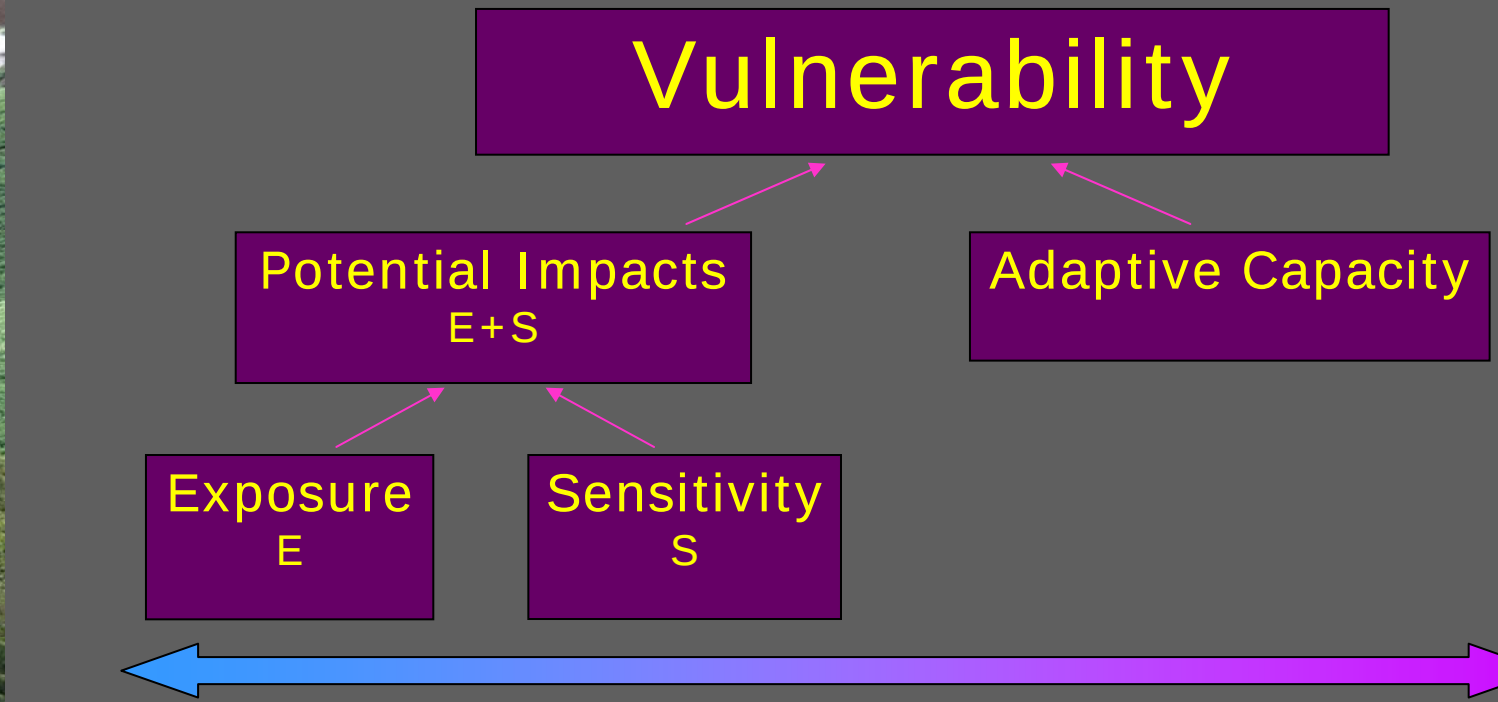


Ecological

Approaches

(Burton et al., 2003; Füssel and Klein, 2006)





Impact assessments

+Global
+Long-term
+Biophysical sciences
+Quantitative

Vulnerability assessments

+Local
+Short-term
+Social sciences
Qualit/Quantit









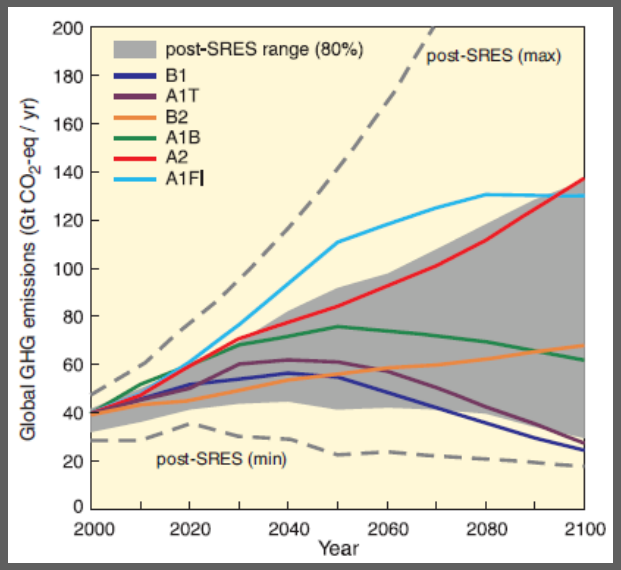
Examples!!!

A. Impact assessments

B. Vulnerability assessments

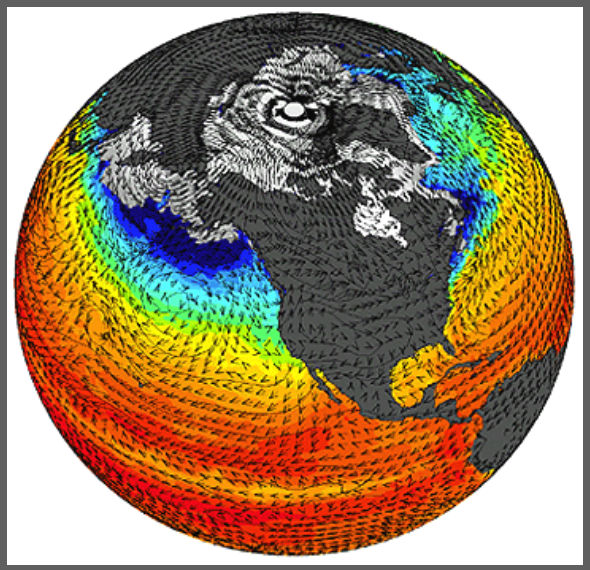
A. Impact assessments

- Exposure (climate change scenarios) + sensitivity model (e.g., ecosystem model)
- Need to consider different climate scenarios



Emission scenarios

X



Global circulation models

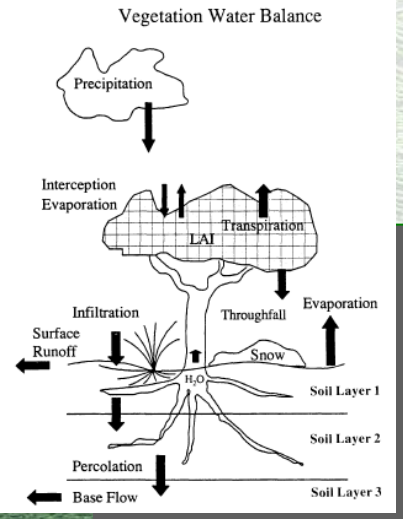








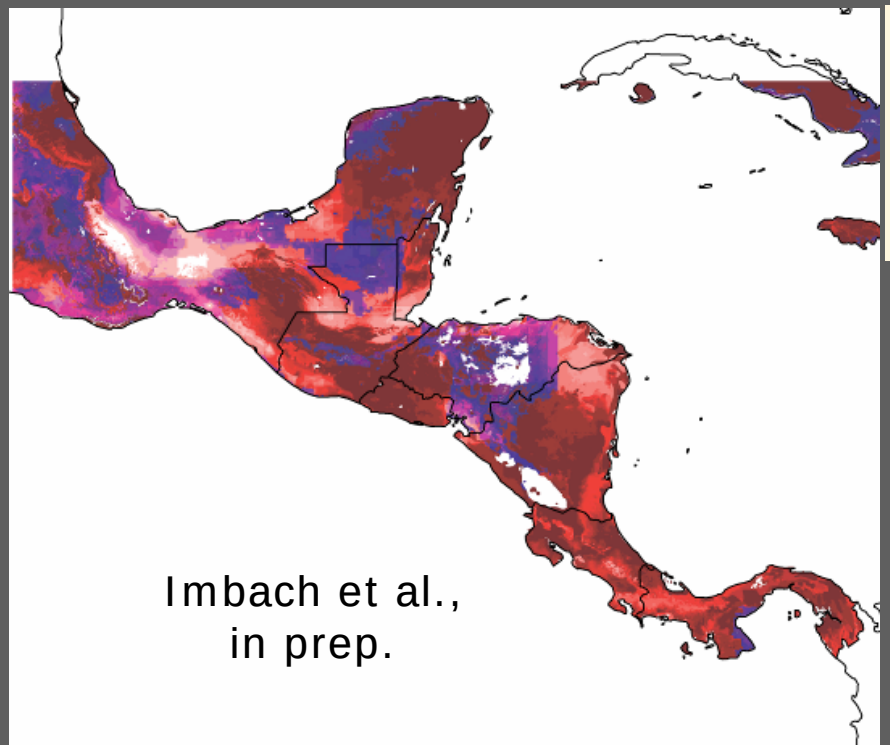
Example



Mapped Atmosphere-Plant-Soil System MAPSS (Neilson, 1995)

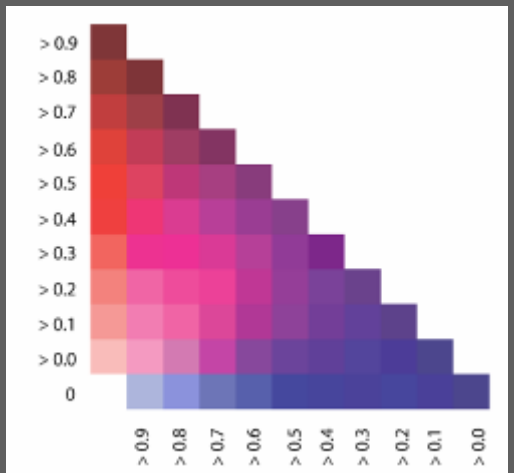
69 climate scenarios (23 GCM x 3 SRES) WCRP CMIP3 multi-model dataset

Future vegetation and hydrology + Uncertainties



Imbach et al., in prep.

Confidence Terminology	Degree of confidence in being correct
Very high confidence	At least 9 out of 10 chance
High confidence	About 8 out of 10 chance
Medium confidence	About 5 out of 10 chance
Low confidence	About 2 out of 10 chance
Very low confidence	Less than 1 out of 10 chance



Only climate scenarios?

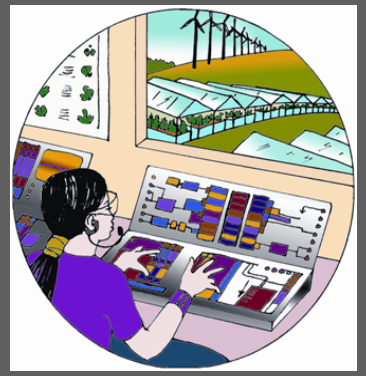
- Socio-economic scenarios also!
- E.g., MEA storylines (Millennium Ecosystem Assessment)

Global Orchestration

Adapting Mosaic

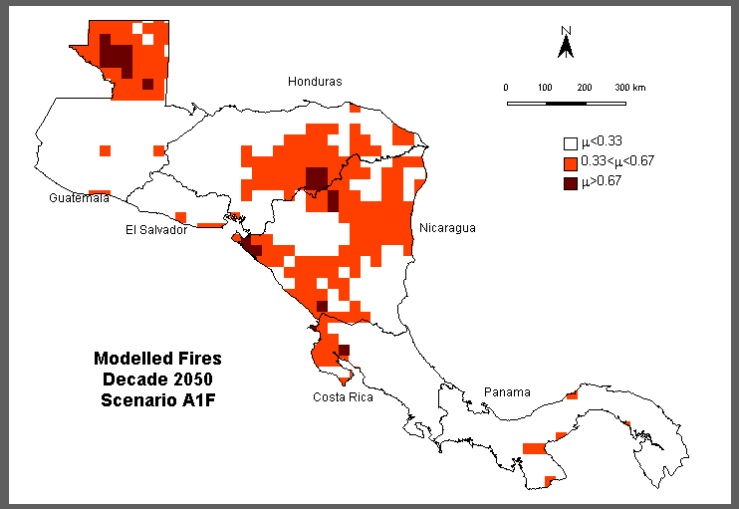
Order from Strength

Techno Garden



Example

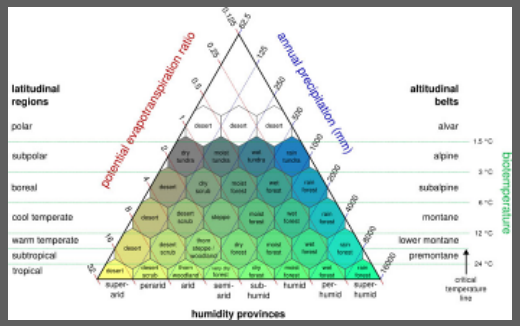
- The future of forest fires
- Forest fires = f (climate, biophysical, socioeconomic factors)
- Method: Data mining with sets of decision trees (“decision forest”)
- Scenarios (IMAGE 2.2)
  - “Market forces”
  - “Security first”
  - “Sustainable development”
  - “Dynamics as usual”



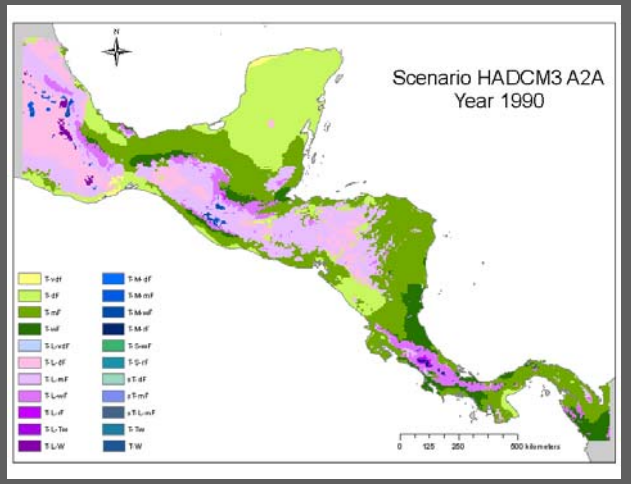
More on uncertainties

- Uncertainties from exposure (scenarios) and sensitivity models

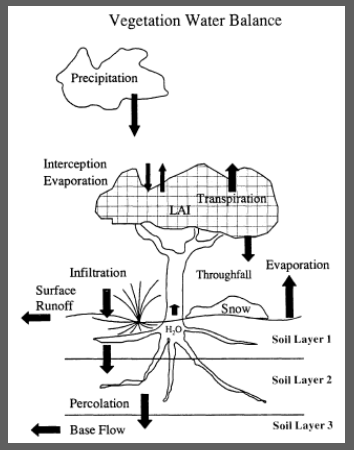
Holdridge bioclimatic classification



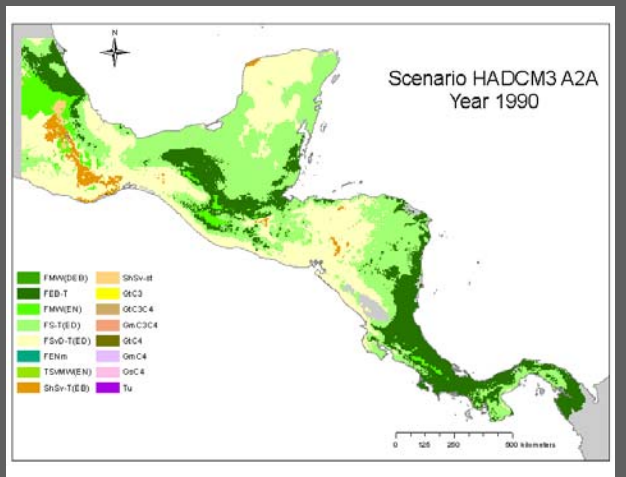
Climate + elevation data



Process-based model:
Mapped Atmosphere-Plant-Soil System (MAPSS)

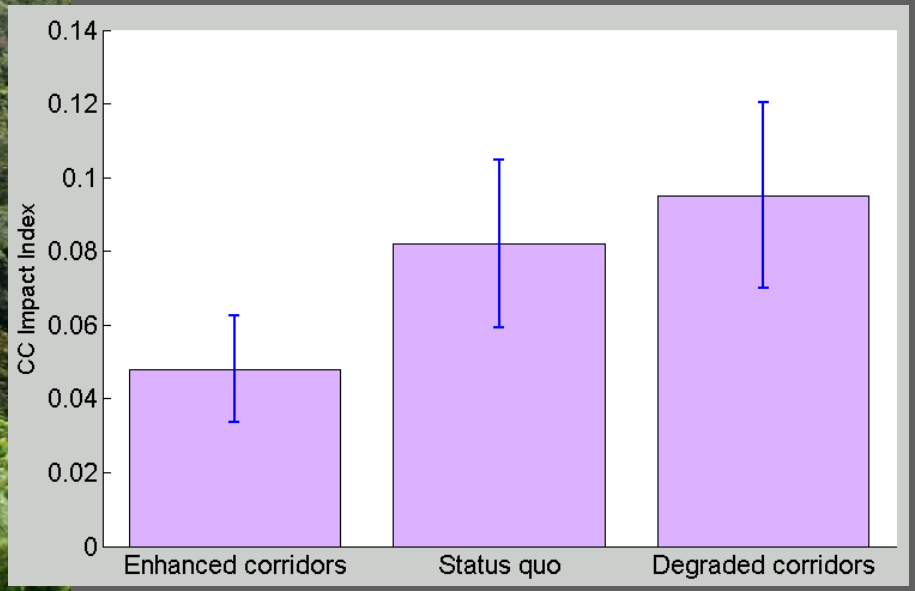


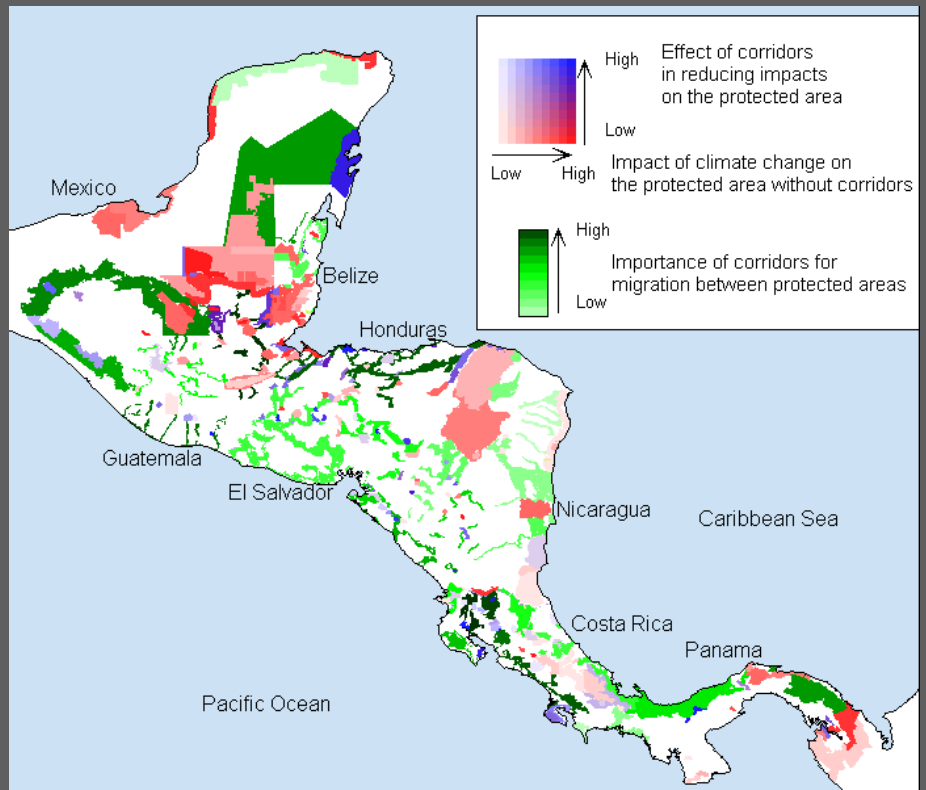
Climate + Soil data



Only impacts?

- Can include adaptation options (“What if...?”)
  - Relevant to policymaking
- Example:
  - Effect of different conservation policies on migration of species between protected areas





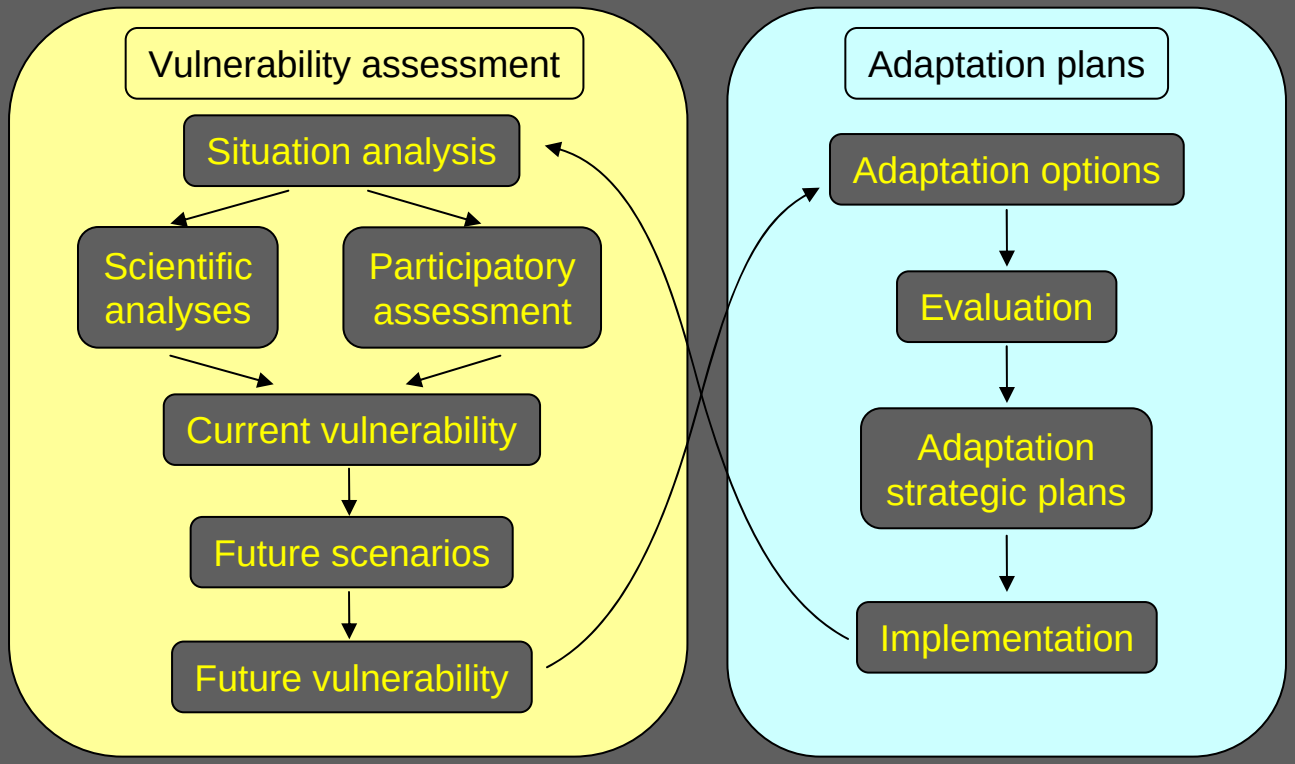
Impact assessments and policy-making

- Nice publications but few policy impacts
- Problems:
  - Communication of uncertainties
  - Temporal and spatial scales
- Role of partnerships
  - Advocacy, information broker…

- Examples:
  - The Nature Conservancy
    - Mainstreaming adaptation into conservation
  - CEPAL (Latin American Economic Commission)
    - Economic valuation of impacts (Stern review)
  - Inputs to the National Communications to the UNFCCC

B. Vulnerability assessment

- As a part of a process of adaptation planning
- Methodological challenges







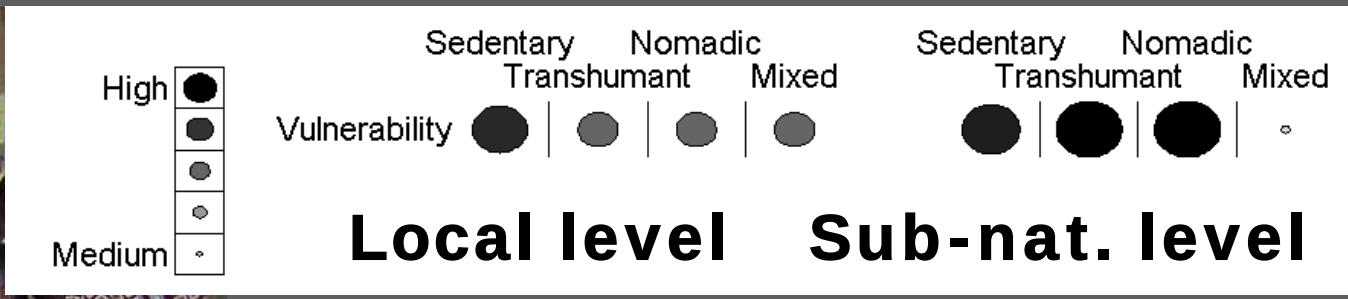




Local assessments but multiple levels

- Different point of views and different levels (local, sub national, national)
  - Analyzing divergent views, identifying risk of maladaptation…
- Participatory approaches across gender and levels

- Example: Mali

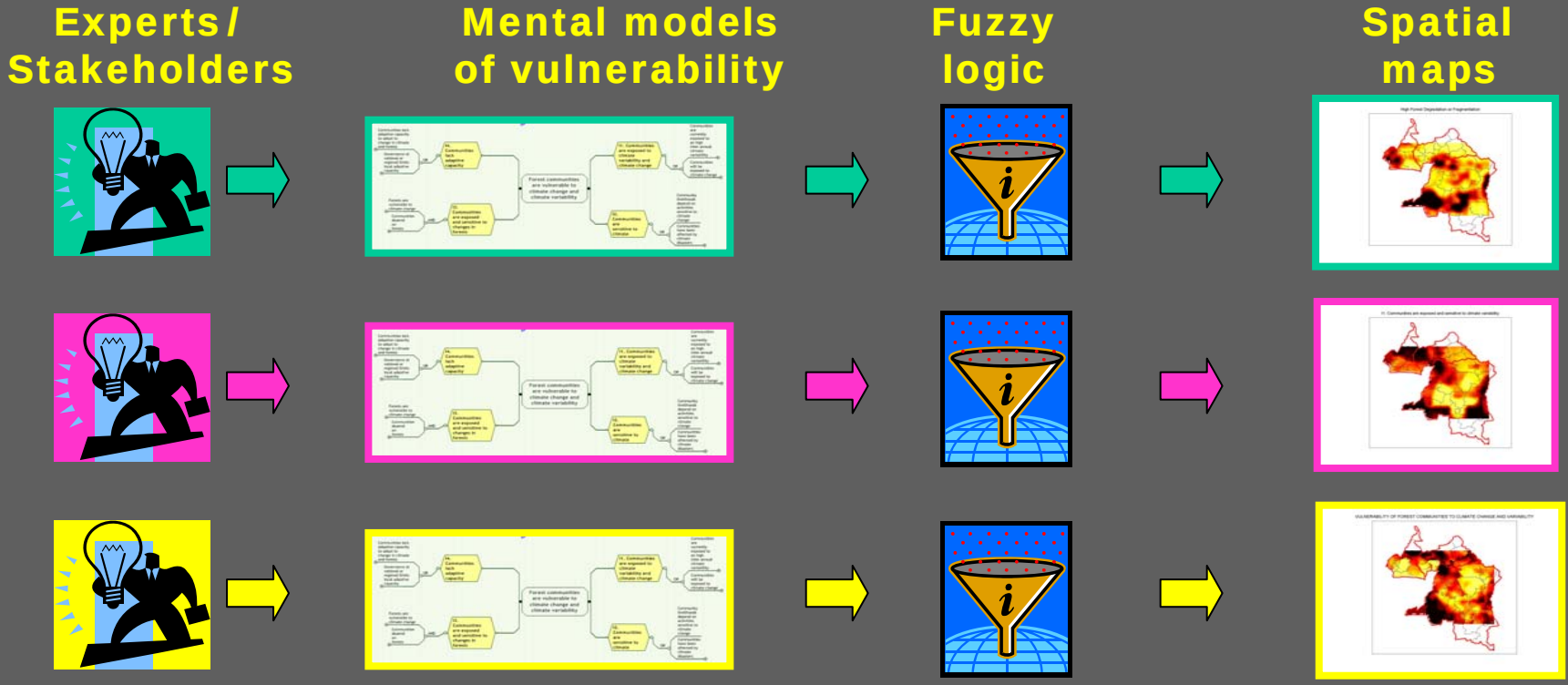


Mobility = Adaptive strategy

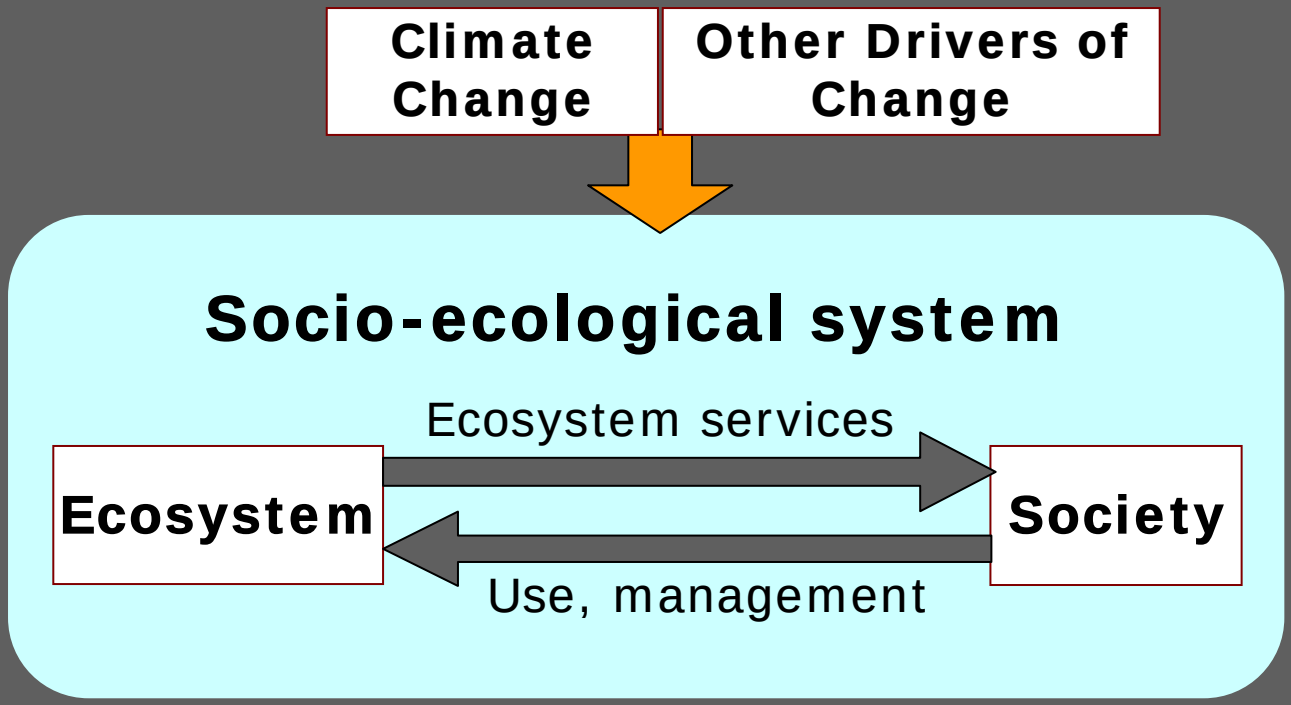
Mobility = Factor of vulnerability

Upscaling local vulnerability assessment

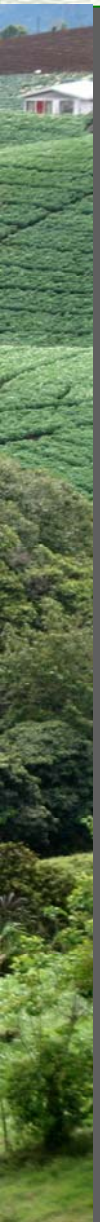
- From local to national
  - Vulnerability mapping
  - Prioritization of adaptation policies/funding
- Example



Integrative approach: Nature and society



- Vulnerability of socio-ecological systems
- Role of ecosystem services in reducing societal vulnerability
- Ecosystem management = an adaptation option



Ecosystem-based adaptation: Examples

Hydroelectricity in Central America

Increasing rainfall intensity. Soil erosion.
Sedimentation in hydroelectric dams.
Upstream soil conservation = Adaptation.

Forest communities in Central Africa

Climate variability affects agriculture/livestock.
Forest products less sensitive than agriculture.
Forests = Safety nets.
Better forest management = Adaptation.

Coastal areas in Asia

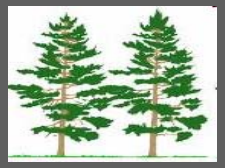
Coast vulnerability (storms, waves, sea level rise).
Protective role of mangroves + provision of goods.
Better mangrove management = Adaptation.

Mapping ecosystem services (example of services for hydroelectricity)

Framework

Eliciting experts' judgment (incl. hydroelectric sector rep.)

Mapping

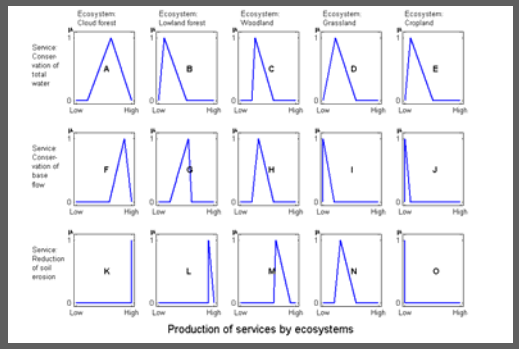


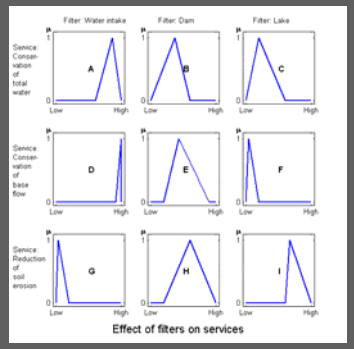
Ecosystems

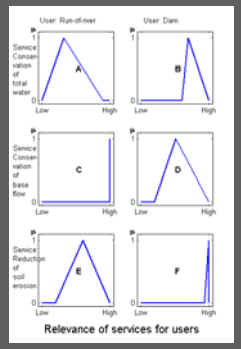
Flow of services

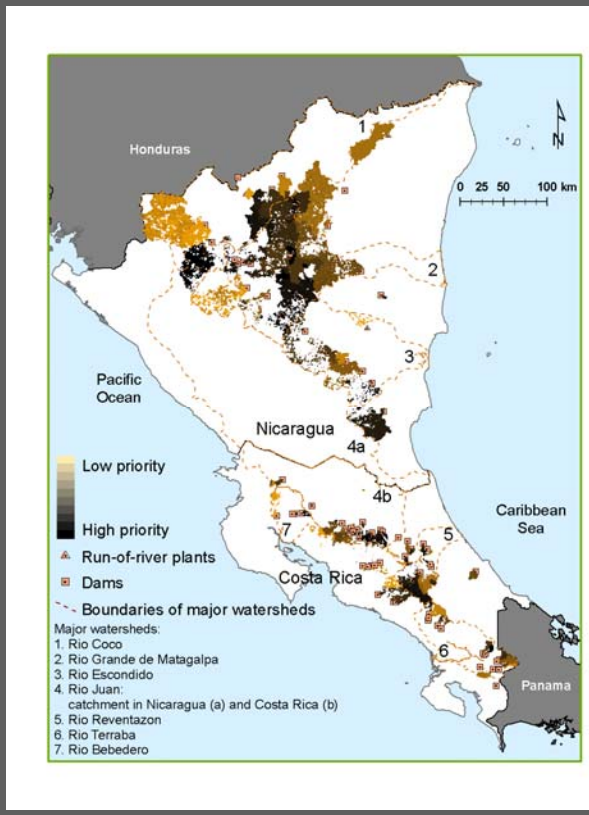
Filters in the landscape

Users









(Locatelli et al., 2010)

Conclusion

- Impact assessments & Vulnerability assessments
  - Different approaches
  - Not so easy to combine
  - Especially because of scale problems
- Options:
  - Using impact studies as “images of the future” in participatory workshop
  - Using vulnerability assessments for defining indicators of adaptive capacity to be combined with impact indicators










Merci !